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The Agglomeration of Urban Amenities: Evidence from Milan Restaurants[†]

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We estimate agglomeration externalities in Milan's restaurant sector using the abolition of a unique regulation that restricted where restaurants could locate. In 2005, Milan abolished a minimum distance requirement that had kept the number of establishments artificially constant across neighborhoods. We find that after 2005, the geographical concentration of restaurants increased sharply and at an accelerating rate. Consistent with the existence of strong and self-sustaining agglomeration externalities, restaurants agglomerated in some neighborhoods and deserted others, leading to a growing divergence in local amenities across neighborhoods. Restaurants located in neighborhoods that experienced large increases in agglomeration reacted by increasing product differentiation. (*JEL* D62, L83, L88, R32, R52)

In many cities, retail establishments tend to be spatially concentrated. Fifth Avenue in New York is a world-renowned cluster of upscale fashion stores. The Diamond Districts of New York and Los Angeles are large concentrations of jewelry stores. Car dealerships and furniture stores are often located near each other. Overall, more than half of stores in the United States are located within a half mile of a competitor (Datta and Sudhir 2011).

Restaurants, bars, and pubs are even more spatially concentrated (Couture and Handbury 2020). The "Gourmet Ghetto" in Berkeley features a concentration of high-quality restaurants, anchored by Chez Panisse. The Fifth Avenue corridor in Brooklyn, the Fourteenth Street corridor in Washington, DC, and the Mission District in San Francisco have emerged as growing clusters of restaurants in their respective communities. Many cities even have "fast-food alleys"—zones characterized by clusters of fast-food outlets (Yang 2012).

The idea that retailers and restaurants find it profitable to locate near their competitors may seem surprising. After all, proximity to competitors should lead to

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fiercer price competition. Economists have long recognized the presence of demand externalities that arise from spatial agglomeration as a possible explanation for geographical clustering (Marshall 1920). A restaurant may generate demand externalities for neighboring rivals if its presence helps attract additional consumer traffic. Restaurants may also profit from shared foot traffic if customers are attracted by the increased diversity of options. In this case, a consumer's utility from shopping in a large cluster is higher than from shopping in a small cluster.[1]

The presence of this type of agglomeration externalities, if they exist, has significant implications for neighborhoods and cities. Since restaurants and entertainment are among the consumption categories with the highest income elasticities (Aguiar and Bils 2015; Leonardi 2015), the agglomeration of restaurants, bars, and retail has been linked to increased attractiveness of certain urban neighborhoods to college-educated professionals and ultimately to increases of housing values (Hurst, Guerrieri, and Hartley 2013; Couture and Handbury 2020; Glaeser, Luca, and Moszkowski 2020). The existence of strong forces of agglomeration in the restaurant and retail sector implies faster and potentially self-sustaining gentrification.

But empirically identifying this type of spillovers is difficult. The mere fact that restaurants and stores are geographically agglomerated within a city does not necessarily imply that agglomeration is caused by externalities. Spatial agglomeration may simply reflect the uneven spatial distribution of demand for restaurants and stores. For example, restaurants may concentrate near a tourist attraction, a ballpark, a busy subway stop, or a university not because of any spillovers but because that is where their potential customers are. In some cities, spatial concentration may also reflect zoning regulations that define where stores and restaurants are allowed to locate.

Due to these challenges, little is known about what exactly causes the spatial agglomeration of restaurants and retail establishments. While the literature on agglomeration economies is extensive, there is little empirical evidence that credibly tests for the existence of neighborhood-level agglomeration economies in the restaurant and retail sector.[2]

In this paper, we focus on restaurants in Milan. We test for the presence of agglomeration spillovers at the neighborhood level and quantify their impact using the abolition of a unique regulation that until recently restricted where restaurants could locate. Before 2005, Milan mandated a minimum distance between restaurants. This meant that new restaurants could not locate too close to an existing restaurant. The regulation mandated shorter distances in neighborhoods with more population and longer distances in neighborhoods with less population, with the effect of keeping the per capita number of restaurants generally constant across

[1] Agglomeration externalities in the retail and restaurant sector are different from those in the tradable sector. Agglomeration economies in the tradable sector are typically thought of as taking the form of productivity increases stemming from labor pooling or human capital spillovers, while agglomeration economies in the retail and restaurant sector reflect demand externalities. Theoretical models of agglomeration that apply to the retail and restaurant sectors include Varian (1980); Stahl (1982); Wolinsky (1993); Dudey (1990); Fischer and Harrington (1996); Bester (1998); and Konishi (2005).

[2] Two notable exceptions are Gould, Pashigian, and Prendergast (2005)—who study externalities generated by name-brand department stores inside malls—and Bernstein et al. (2019)—who use bankruptcies to estimate spillovers. Eppli and Benjamin (1994) and Vitorino (2012) are examples of studies that lack credible identification.

neighborhoods. This regulation effectively kept the spatial distribution of restaurants artificially uniform. The minimum distance regulation did not apply to retail establishments.

The regulation was abolished in 2005 by a nationwide reform that allowed new restaurants to locate anywhere in the city, irrespective of the location of existing restaurants. Using administrative data on the universe of restaurants and retail establishments in Milan between 2000 and 2012, we study the changes in the spatial distribution of restaurants after the 2005 reform. In the presence of agglomeration externalities, one might expect that in the years following the reform, Milanese restaurants, freed from the minimum distance constraint, became more geographically agglomerated. Finding that the amount of agglomeration did not change would cast doubt on the existence of agglomeration benefits and would imply that the agglomeration typically observed in many cities reflects unobserved heterogeneity in consumer demand across areas and/or zoning constraints. This is one of the few studies that identify agglomeration economies using policy-induced variation in firm location choices.

We first establish empirically that before 2005 restaurants were distributed homogeneously across neighborhoods, confirming that the regulation was binding. A Kolmogorov-Smirnov test fails to reject that the distribution of the per capita number of restaurants across neighborhoods in 2004 is equal to a homogeneous distribution. We also find no evidence of pre-trends in the geographical agglomeration of restaurants between 2000 and 2004, indicating that in the years before the reform, the spatial concentration of restaurants in Milan was both uniform and stable.

The spatial distribution of restaurants changed dramatically after the 2005 reform. Some neighborhoods attracted a large number of new restaurants, while other neighborhoods lost most of their restaurants. By 2012, seven years after the liberalization of restaurant entry, the city's restaurants were significantly more spatially concentrated than before liberalization.

Three alternative measures of spatial dispersion across neighborhoods all increased sharply between 2004 and 2012. The standard deviation of the per capita number of restaurants, the interquartile range, and the difference between neighborhoods at the ninetieth and tenth percentiles increased by 26.7 percent, 30.9 percent, and 24.4 percent, respectively.

The magnitude of these increases is economically large and points to a profound shift in the degree of geographical concentration of restaurants in Milan, consistent with the existence of significant agglomeration externalities. By contrast, not much happened to the spatial concentration of retail establishments or even retail establishments that sell food, which were never covered by the minimum distance regulations and therefore were not directly affected by its reform.

Unlike New York, Los Angeles, or London, Milan did not have a "restaurant area" in 2004. By 2012, Milan developed several restaurant areas. But despite its significant increase, the degree of spatial concentration in Milan seven years after the reform remained low when compared to the one in New York and Los Angeles: the standard deviation of the per capita number of restaurants across neighborhoods was only half of the corresponding figure for New York and Los Angeles. However, spatial concentration in Milan was still growing in 2012, suggesting that the process of agglomeration was ongoing.

It is possible that the winners attracted more restaurants not just because of agglomeration externalities but also because they have better fundamentals—better transit, better local amenities, or lower crime. We can't completely rule out this possibility. But we find that the 2004 observable characteristics of neighborhoods—including real estate prices (residential and commercial), transit access, proximity to local attractions, restaurant characteristics, the number and growth of retail establishments—are jointly orthogonal to the 2004–2012 change in the number of restaurants.

In the final part of the paper, we study the effects of agglomeration on product differentiation on the part of restaurants. In the presence of agglomeration spillovers, increased spatial agglomeration benefits restaurants by attracting more consumers to a neighborhood, but it also increases competition from nearby rivals. Some theoretical models predict that restaurants will react to the increased competition by differentiating themselves from their nearby competitors more than geographically isolated restaurants (Fujita and Thisse 1996, 2002).

We investigate whether restaurants located in neighborhoods that experienced large increases in agglomeration after the 2005 reform reacted by increasing product differentiation compared to restaurants located in neighborhoods where agglomeration did not increase or declined. We measure differentiation using restaurant-level data on the price of a meal, consumer quality ratings, and the type of cuisine. A neighborhood that has restaurants with a diverse range of prices, qualities, and types of cuisines is defined as having more differentiated restaurants than a neighborhood that has restaurants with similar prices, qualities, and types of cuisines. We conduct this analysis on the subset of establishments (31.7 percent and 33.9 percent of sit-down restaurants in 2004 and 2012, respectively) for which we have data on price, quality, and cuisine. We find that in neighborhoods where the number of restaurants grew the most after the 2005 reform, restaurants reacted to the increased competition by becoming more differentiated based on price, quality, and type of cuisine.

Overall, we conclude that agglomeration externalities are important in determining both the location of restaurants across neighborhoods within a city, and their variety. We infer that the spatial concentration of establishments that we observe in many cities reflects—at least in part—endogenous agglomeration economies, not simply exogenous neighborhood characteristics or zoning constraints. Agglomeration economies in Milan appear to be strong enough to profoundly affect the quantity and quality of the consumption amenities available in each neighborhood. Furthermore, the increase in the agglomeration of restaurants that we observe in Milan after the reform did not all take place immediately, but grew over the years at an accelerating rate. As some neighborhoods attracted more restaurants, they became more attractive and attracted even more, leading to accelerating divergence in local amenities across neighborhoods. These dynamics are consistent with models of self-reinforcing agglomeration and multiple equilibria.

These findings are of particular interest to policymakers seeking to foster the revitalization of urban neighborhoods. Forty percent of local governments in the United States use retail incentives to improve neighborhood attractiveness and foster local economic development (ICMA 2009). In essence, these types of policies seek to move struggling neighborhoods from a bad to a good equilibrium by increasing the

number of new stores and restaurants (Shoag and Veuger 2018). A key question for policymakers is whether agglomeration externalities exist and are strong enough to sustain the new equilibrium once the incentives are phased out.[3] Our findings indicate that this may be the case, at least in Milan.

This paper contributes to a growing literature that identifies consumption amenities as an important determinant of an area's attractiveness (Glaeser, Kolko, and Saiz 2001). Most of the literature has focused on differences across cities. Recently, Diamond (2016) has shown that cities that attract skilled residents become endogenously more desirable as their local amenities improve, and this, in turn, tends to magnify sorting. Our findings indicate that a similar pattern arises at the neighborhood level within a city, with the endogenous clustering of restaurants in some areas generating a self-sustaining divergence across neighborhoods.

Our findings on product differentiation relate to the broader literature that identifies the increased variety of goods and services as a key benefit of density (Handbury and Weinstein 2014; Couture 2016). Our findings are consistent with cross-city evidence by Berry and Waldfogel (2010) and Schiff (2015), who document that the range of cuisines available in a city increase with its size.

I. The 2005 Reform

Before 2005, Milan had regulations that strictly limited entry into the restaurant sector. The regulations stem from a national law that mandated that municipalities enforce a minimum distance between restaurants. In practice, this meant that municipalities could not issue permits for new restaurants that were too close to an existing restaurant. Minimum distances were allowed to vary across cities and neighborhoods as a function of potential demand. The restriction applied not only to sit-down restaurants but also to fast-food establishments, bars, cafes, and most other venues where food and drinks are consumed. Retail establishments were not subject to the minimum distance constraint. We don't have the exact formula that was used to define the minimum distance in Milan. But we know that it was based on neighborhood population, including both residents and commuters. Specifically, the law mandated shorter distances in areas with more population and longer distances in areas with less population, with the overall goal of keeping the per capita number of restaurants generally constant across neighborhoods (Comune di Milano 2004).

In practice, the minimum distance rule succeeded in creating a spatial distribution of restaurants that was generally homogeneous, with the same per capita number of restaurants in each neighborhood, as we show in Section III.

In 1998, Italy adopted a sweeping reform of commerce legislation, known as the "Bersani reform" (Viviano 2008; Schivardi and Viviano 2011). Among other things, the reform allowed regions to abolish the minimum distance rule. In response, the Lombardy region greatly relaxed the minimum distance constraints starting in 2005. In practice, this meant that starting in 2005 restaurants in Milan were effectively not subject to minimum distance constraints (Comune di Milano 2010). Rather, a new restaurant could open anywhere it could find a suitable space.

[3] A similar question arises in the case of big-push economic development policies that seek to move entire regions from a bad to a good equilibrium (Kline and Moretti 2014).

II. Data

Our main source of data is an administrative dataset that includes the universe of all restaurants and retail establishments in the city of Milan between 2000 and 2012. We obtained it from the Planning Department of the City of Milan. The data are of high quality because they are based on the licenses that establishments are required to obtain to operate.

For each establishment, the data report address and category. Based on category, we divide establishments in two groups: restaurants and retail establishments. "Restaurants" include sit-down restaurants, pizzerias, fast-food establishments, cafes, bars, pubs, and cafeterias. "Retail" includes all other establishments, excluding restaurants. In 2004, the data contain 6,057 restaurants and 24,748 retail establishments.

We further subdivide retail into establishments selling food—groceries, bakeries, fruit and vegetable stores, salumerias, and butchers—and those not selling food.

Our spatial unit of analysis is an administrative zone, which throughout the paper we refer to as a "neighborhood." Administrative zones are defined by the Planning Department to approximate neighborhoods. Milan has 180 administrative zones, with a mean daytime population of 8,361 residents.

We define the per capita number of restaurants or retail establishments in each neighborhood as the number of restaurants or retail establishments in the neighborhood divided by the daytime population of the neighborhood (in thousands of people). Data on daytime population by neighborhood are from the 2001 Census of Population. The census defines daytime population as the sum of the residential population and the commuter population who works there but does not reside there. In neighborhoods with a lot of office space, the daytime population is a better measure of demand for restaurants than the residental population.

For a subset of restaurants, we were able to obtain information on cuisine type, price of a meal, and consumer ratings of food, ambience, and service from *Il Mangelo*, which during our sample period was one of the most popular restaurant guides in Milan.[4] We hand-entered the data from the 2004 and 2012 print editions. The data are available for 811 restaurants in 2004 (13.3 percent of all restaurants; 31.7 percent of sit-down restaurants) and 982 in 2012 (14.1 percent of all restaurants; 33.9 percent of sit-down restaurants). While *Il Mangelo* includes only a sample of the restaurants in the city, it covers all neighborhoods, price levels, and cuisines.

Data on real estate prices are from the Agenzia delle Entrate (the Italian Revenue Agency). They include the mean sale prices per square meter by neighborhood based on the universe of transactions, separately for residential and commercial (stores and restaurants) properties. Finally, we added indicators for whether a neighborhood has a restaurant mentioned in the *MICHELIN Guide*, a subway stop, a college or university building, and a significant tourist attraction.

Table 1 in the online Appendix shows the summary statistics.

[4] Yelp was not widely used in 2004.

III. Empirical Analysis

A. *Spatial Distribution before the Reform*

The first map in Figure 1 shows the per capita number of restaurants in Milan by neighborhood (relative to the city average) in 2004—the year before the removal of entry constraints. The per capita number of restaurants is not exactly the same across neighborhoods. This reflects the fact that we don't have the exact formula that was used to define the minimum distance, and some violations may have been grandfathered in when the regulation was adopted.[5] For comparison, online Appendix Figures 5 and 6 show the distribution of the per capita number of retail and food retail establishments.

A statistical test fails to reject that the distribution of the per capita number of restaurants across neighborhoods is equal to a homogeneous distribution. Specifically, we performed a Kolmogorov-Smirnov test on the distance between the sample and the theoretical uniform function, where the unit of observation is the neighborhood and the statistic is the number of restaurants per capita in that neighborhood. The *p*-value is 0.990, indicating that we can't reject that in 2004 restaurants are homogenously distributed across neighborhoods. This is not the case for retail or food retail establishments: the test rejects the hypothesis of uniform distribution (*p*-values: 0.000 and 0.000, respectively).

Thus, consistent with the minimum distance regulation, the geographical distribution of restaurants shows no sign of statistically significant geographical agglomeration in 2004: the per capita number of restaurants in 2004 is statistically similar in all neighborhoods. By contrast, the retail and food retail sectors, which have never been subject to entry constraints, are not homogenously distributed over space but are more concentrated in some neighborhoods than others.

B. *Spatial Distribution after the Reform*

The lifting of the minimum distance regulations in Milan resulted in an increase in the total number of restaurants in the city. While the number of restaurants was approximately stable before 2004, in the period between 2004 and 2012 the number of restaurants grew by 14.4 percent. The fact that the number of restaurants increased significantly after the reform suggests that the entry regulation was binding for the entire city. By contrast, the 2004–2012 increase in the number of retail establishments and food retail establishments was only 2.0 percent and 1.8 percent, respectively. Thus, the increase in the number of restaurants did not reflect a citywide surge in the entire retail sector but was specific to the restaurant sector, which was the only one affected by the reform of minimum distance.

For our purposes, the most interesting effect of the reform is not on the overall number of restaurants in Milan but on their location. In the presence of forces of agglomeration, we should see that after the reform, restaurants, freed from the

[5] In addition, there is some measurement error in daytime population stemming from a slight discrepancy between the census geographical unit of analysis and ours. We have no reason to expect that the variance of this measurement error is time varying, so it shouldn't affect our estimates.

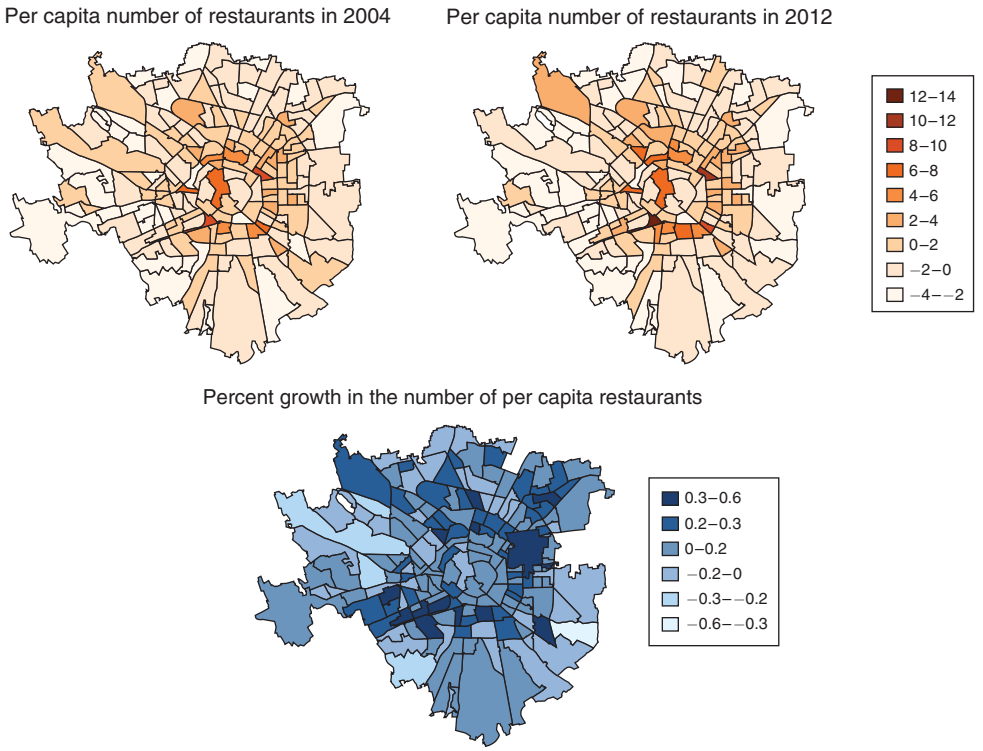

FIGURE 1. PER CAPITA NUMBER OF RESTAURANTS BY NEIGHBORHOOD IN 2004 AND 2012 (RELATIVE TO CITY AVERAGE) AND PERCENT CHANGE BETWEEN 2004 AND 2012

Notes: The map shows the per capita number of restaurants in each neighborhood in 2004 and 2012, relative to the city average, and the percent growth 2004–2012. There are 180 neighborhoods.

minimum distance constraint, tend to concentrate geographically. If, instead, we find that restaurants remain homogeneously distributed across neighborhoods, it would cast doubt on the existence of agglomeration forces in this sector.

We first repeat the Kolmogorov-Smirnov test for whether the spatial distribution of per capita restaurants is a uniform distribution, this time using 2012 data. The *p*-value is now 0.000. Thus, while the 2004 spatial distribution of restaurants was statistically indistinguishable from a uniform distribution, by 2012 the spatial distribution was statistically different from a uniform distribution. Put differently: in 2004—the year before the reform—each neighborhood had roughly the same per capita number of restaurants. By 2012—seven years after the reform—this was not true anymore.

The change occurred because restaurant growth after 2004 was highly heterogeneous across neighborhoods, with restaurants clustering in some neighborhoods and deserting other neighborhoods, ultimately resulting in a vast increase in spatial agglomeration. Of the 180 neighborhoods in Milan, 131 experienced an increase in the per capita number of restaurants between 2004 and 2012, with 55 neighborhoods experiencing a large increase (+20 percent or more). By contrast, 49 neighborhoods experienced a decrease between 2004 and 2012, with 6 neighborhoods experiencing a large decrease (−20 percent or more).

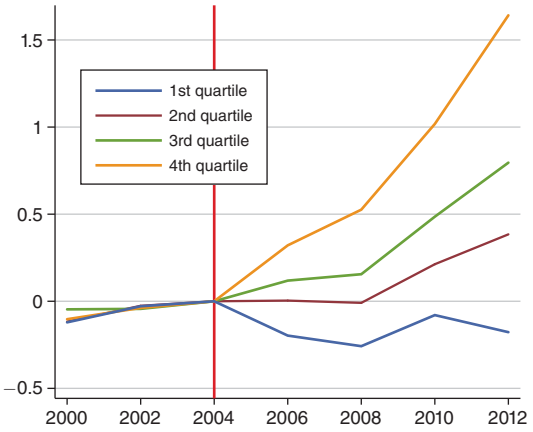

FIGURE 2. PER CAPITA NUMBER OF RESTAURANTS BY YEAR AND QUARTILE OF 2004–2012 GROWTH

Notes: The unit of analysis is a neighborhood. There are 180 neighborhoods. Neighborhoods are divided into quartiles based on the percent change in per capita number of restaurants between 2004 and 2012. The first quartile includes neighborhoods with the smallest percent change between 2004 and 2012. The fourth quartile includes neighborhoods with the largest percent change between 2004 and 2012. For each quartile, the figure shows the per capita number of restaurants between 2000 and 2012, normalized so that it has mean 0 in year 2004.

Figure 2 shows visually the resulting increase in geographical dispersion. We divide neighborhoods in quartiles, based on their 2004–2012 growth in per capita number of restaurants, and plot the evolution of the per capita number of restaurants over time for each quartile. For ease of comparison, we normalize the variable so that it is zero in 2004 for all quartiles.

The figure shows that in the years before 2004, the four groups had similarly flat pre-trends. The lack of pre-trends is important because it indicates that there is no evidence of the effects of the reform before the reform took place. This is true for all four groups of neighborhoods, irrespective of their postreform experience.

After 2004, however, the figure shows an accelerating divergence in the per capita number of restaurants. Had the spatial distribution of restaurants stayed roughly uniform after the reform, the four lines would have been near each other. Instead, the four lines diverge dramatically, with the top two quartiles (quartiles 3 and 4) experiencing a boom in the number of restaurants, the second quartile experiencing a modest increase, and the bottom quartile experiencing a decline. The growth in the top two quartiles in particular appears to follow a convex trend, suggesting that agglomeration of restaurants in this group of neighborhoods may be accelerating, which would be consistent with self-reinforcing agglomeration dynamics. As a neighborhood attracts more restaurants, it becomes more attractive and attracts even more, leading to accelerating concentration.

The left side of Figure 3 provides an alternative way of documenting the increase in concentration that took place after 2004. It shows the evolution over time of three alternative measures of spatial dispersion across neighborhoods: the standard deviation in the per capita number of restaurants, the difference in the per capita number of restaurants between neighborhoods at the ninetieth and tenth percentiles, and the interquartile range, which is the difference between neighborhoods at

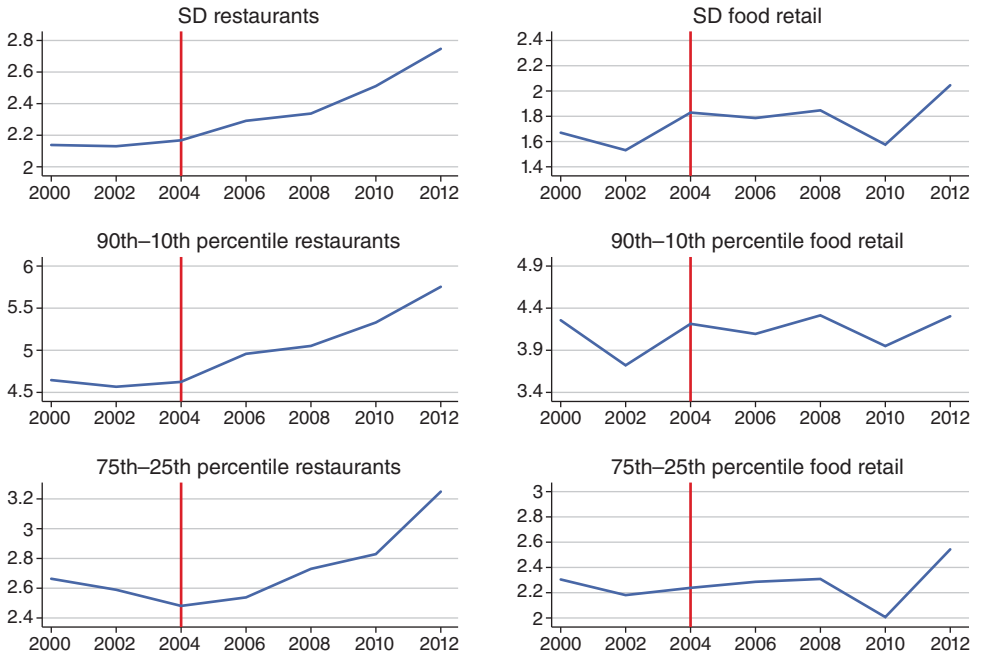

Figure 3. Three Measures of Spatial Dispersion by Year

Notes: The unit of analysis is a neighborhood. There are 180 neighborhoods. For each year in the data, the top two figures show the standard deviation across neighborhoods of the per capita number of restaurants and food retail establishments, respectively. The two figures in the middle show the difference in the per capita number of restaurants and food retail establishments between the neighborhood at the ninetieth percentile and the neighborhood at the tenth percentile. The two figures at the bottom show the difference in the per capita number of restaurants and food retail establishments between the neighborhood at the seventy-fifth percentile and the neighborhood at the twenty-fifth percentile.

the seventy-fifth and twenty-fifth percentiles. These measures capture how spatially agglomerated restaurants are in each year. In a city where each neighborhood has roughly the same per capita number of restaurants, spatial agglomeration would be limited and the three measures of dispersion would be low. By contrast, in a city where most of the restaurants are concentrated in a small number of neighborhoods, spatial agglomeration would be pronounced and the three measures would be high. We are interested in how these three measures were trending in the years before the reform and how they have changed in the years after the reform.

The figure shows that there is no evidence of an increase in agglomeration before the reform. Consistent with what we found in Figure 2, spatial agglomeration was stable in the years before the reform. If anything, the 75–25 difference was slightly declining. By contrast, all three measures of agglomeration increased significantly after 2004, suggesting that the reform resulted in more geographical inequality in the number of restaurants across neighborhoods.

The figure also shows that the increase in agglomeration did not all take place immediately. Instead, agglomeration grew over the years. Interestingly, the rate of growth appears to be accelerating over time, especially when measured by the interquartile range and the 90–10 difference, as one might expect from models of self-reinforcing agglomeration.

The magnitude of these increases is quantitatively large: between 2004 and 2012 the standard deviation, the interquartile range, and the 90–10 percentile difference increased by 26.7 percent, 30.9 percent, and 24.4 percent, respectively. The economic magnitude of these changes points to a profound shift in the degree of geographical concentration of restaurants in Milan, consistent with the existence of significant agglomeration externalities.

Milan did not have a "restaurant area" in 2004. By 2012, Milan had developed several restaurant areas. Examples of neighborhoods that experienced particularly large increases in the concentration of restaurants are administrative zones 101 and 104 (Navigli), 159 (Isola), and 88 (Idroscalo). The second and third maps in Figure 1 show where the growth occurred.

Despite its significant increase after 2004, the 2012 degree of spatial agglomeration in Milan remained low compared to the one in other cities like New York and Los Angeles. Using Yelp data, we estimate that the 2017 standard deviation of the per capita number of restaurants across zip codes in New York and Los Angeles was 5.41 and 5.32, respectively, double the standard deviation in Milan (2.74).[6] Thus, seven years after the reform, the amount of agglomeration in Milan was only half of what was observed in the two other cities. On the other hand, Figures 2 and 3 indicate that spatial concentration in Milan was still growing by 2012, and possibly accelerating, suggesting that the process of agglomeration was ongoing and that the degree of agglomeration may increase further in the following years.

In principle, one may be concerned that the increased concentration of restaurants reflects unobserved changes in the location of consumers, rather than endogenous agglomeration triggered by the reform. Possible examples of shocks that could alter the location of consumers are changes in the location of office space or changes in the public transportation network.

However, the right side of Figure 3 shows that there is little evidence of a comparable increase in the geographical concentration of food retail establishments.

Online Appendix Table 2 compares more formally changes in the geographical concentration of restaurants with changes in the geographical concentration of retail establishments and food retail establishments. The top panel focuses on restaurants. In the 2004–2012 period, the standard deviation increased by 0.579, significantly more than in the 2000–2004 period (0.029). The same was true for the 90–10 and 75–25 percentile differences. The last row in the panel reports the difference-in-difference estimates, obtained by taking the difference between the 2004–2012 change and the 2000–2004 change. Bootstrapped standard errors are reported in parentheses. Entries show that for all three variables the difference-in-difference estimates are positive and statistically significant.

The middle and bottom panels confirm that these increases were limited to the restaurant sector and did not extend to the retail and food retail sectors. In particular, the difference-in-difference estimates at the bottom of the panels indicate that the agglomeration of retail and food retail establishments after the reform either declined or remained unchanged relative to the trend before the reform. This finding

[6]The means (per 1,000 people) are 3.0, 2.2, and 4.1, respectively. The comparison is not perfect because the year and the geographical unit of analysis are not identical. We have no reason to think that the agglomeration measured in New York and Los Angeles in 2017 is significantly different from the one that existed in 2012.

is inconsistent with the notion that the increased agglomeration in the restaurant sector reflects unobserved changes to the spatial concentration of consumers.

Overall, Figures 2 and 3 and online Appendix Table 2 paint a clear picture. While the overall number of restaurants in Milan increased after the liberalization of restaurant entry, the gains were far from uniform across areas. Some neighborhoods attracted large numbers of new restaurants, while other neighborhoods lost most of their restaurants. By 2012, seven years after the reform, the city's restaurants were significantly more spatially concentrated than before the reform. The lack of pre-trends and the lack of significant increases in the retail sector support a causal interpretation of the increases in restaurant concentration after 2004 as an effect of endogenous agglomeration economies triggered by the reform.

Neighborhood Characteristics.—It is in principle possible that the winners among neighborhoods attracted more restaurants because they had better unobservables. If restaurants, freed up by the constraints of minimum distance regulation, concentrated in areas with characteristics that appeal to consumers—better transit, better local amenities, lower crime, and so forth—then our findings might simply reflect unobserved neighborhood heterogeneity rather than agglomeration spillovers.

We investigate whether the neighborhoods that attracted more restaurants after 2004 were neighborhoods with initially better characteristics. While we observe only a subset of all the possible determinants of an area's attractiveness, three of our variables are particularly informative as measures of overall neighborhood attractiveness to consumers before the reform: the 2004 mean price of commercial properties in the neighborhood, defined to include stores and restaurants; the 2004 number of retail establishments; and the 2000–2004 growth in the number of retail establishments. Retail was not regulated, so neighborhoods that were more attractive to consumers presumably had more retail establishments in 2004. For the same logic, up-and-coming neighborhoods that were becoming more attractive to consumers before 2004 presumably experienced faster growth in establishments before 2004.

Column 1 of Table 1 reports estimates of a regression of the change in the log per capita number of restaurants between 2004 and 2012 in a neighborhood on its 2004 observable characteristics, including mean housing price, mean price of commercial units (stores and restaurants), an indicator for the presence of a subway stop, an indicator for the presence of a college or university, an indicator for the presence of a major tourist attraction, daytime population, per capita number of restaurants, mean price of restaurants, mean quality ratings for restaurants, and an indicator for the presence of a MICHELIN restaurant. Most coefficients are insignificant. An F-test at the bottom reveals that the coefficients are jointly not different from zero (p-value: 0.29).

In column 2, we add the 2004 number of per capita retail and food retail establishments, while in column 3, we add the 2000–2004 change in the per capita number of retail and food retail establishments. In column 4, we add both sets of variables.

The coefficients on retail and food retail are insignificant, both in levels and in changes, suggesting that the 2004–2012 growth in per capita restaurants is orthogonal to the initial number of per capita retail and food retail establishments, and their trend over time. Importantly, the F-test p-value in column 4 is 0.43, indicating that taken together the coefficients are jointly not statistically significant.

Table 1—2004–2012 Change in Per Capita Number of Restaurant and Initial Neighborhood Characteristics

	(1)	(2)	(3)	(4)	(5)
Mean housing price in 2004 (euros per square meter)	0.053	0.065	0.068	0.077	0.143
	(0.110)	(0.111)	(0.111)	(0.113)	(0.056)
Mean commercial price in 2004 (euros per square meter)	−0.010	−0.010	−0.023	−0.025	0.137
	(0.095)	(0.096)	(0.096)	(0.098)	(0.045)
Subway stop in 2004	−0.004	−0.001	−0.002	0.002	−0.043
	(0.026)	(0.026)	(0.027)	(0.027)	(0.029)
College or university in 2004	0.063	0.060	0.058	0.057	0.068
	(0.072)	(0.072)	(0.072)	(0.073)	(0.085)
Tourist attraction in 2004	−0.134	−0.168	−0.121	−0.146	−0.082
	(0.140)	(0.156)	(0.142)	(0.158)	(0.109)
Daytime population in 2001	−0.000	−0.000	−0.000	−0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Per capita number of restaurants in 2004	0.005	0.002	0.003	0.001	0.021
	(0.006)	(0.010)	(0.006)	(0.010)	(0.006)
Mean restaurant price in 2004	−0.003	−0.003	−0.003	−0.003	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Mean consumer rating in 2004	0.012	0.010	0.011	0.009	−0.021
	(0.028)	(0.028)	(0.028)	(0.028)	(0.020)
MICHELIN restaurant in neighborhood in 2004	0.019	0.024	0.019	0.022	0.052
	(0.028)	(0.029)	(0.029)	(0.029)	(0.032)
Per capita number of retail est. in 2004		−0.002		−0.001	0.004
		(0.003)		(0.003)	(0.001)
Per capita number of food retail est. in 2004		0.014		0.010	0.022
		(0.012)		(0.015)	(0.008)
Change in per capita retail est. 2000–2004			−0.135	−0.109	0.073
			(0.102)	(0.110)	(0.093)
Change in per capita food retail est. 2000–2004			0.079	0.044	0.049
			(0.070)	(0.087)	(0.064)
Coefficients jointly significant (p-value)	0.29	0.35	0.31	0.43	
R^2	0.085	0.095	0.099	0.103	

Notes: Standard errors in parentheses. Housing and commercial prices are in logs. Entries in columns 1–4 are from separate regressions (one regression per column). In column 5, each row is the coefficient from a separate bivariate regression. $N = 140$.

Overall, columns 1–4 indicate that the 2004 observable characteristics of neighborhoods are not predictive of the changes in the concentration of restaurants. However, it is impossible to draw definitive conclusions. First, we only observe some but not all possible relevant neighborhood characteristics. We can't rule out the presence of important unobserved heterogeneity. Second, the variables that we do observe likely contain measurement error. Third, our sample is small since the number of neighborhoods is small, and the standard errors are large. Finally, when separate regressions are estimated for each of the neighborhood characteristics, six coefficients are statistically significant, suggesting that taken in isolation, several neighborhood characteristics can predict agglomeration (column 5).

C. *Changes in Restaurant Differentiation*

Theoretical work has posited that when restaurants and stores agglomerate geographically, they have an incentive to differentiate themselves from their rivals

(Fujita and Thisse 1996, 2002). Intuitively, a restaurant that locates near many competitors has a stronger incentive to differentiate itself from its rivals than a restaurant that is geographically more isolated.

In this subsection, we investigate whether there is evidence of larger increases in product differentiation in neighborhoods where the number of restaurants significantly increased after the reform compared to neighborhoods where the number of restaurants increased less or decreased. To quantify product differentiation among restaurants in a given neighborhood, we use three alternative measures: the standard deviation of the price of a meal across restaurants within a neighborhood, the standard deviation of consumer quality ratings, and the diversity of cuisines. A neighborhood that has restaurants with a diverse range of prices, qualities, and types of cuisines is defined as having more product differentiation than a neighborhood that has restaurants with similar prices, qualities, and types of cuisines. Price refers to the price of an average meal in euros, food quality ratings range from four stars to ten stars, and type of cuisine is defined as an indicator for ethnic cuisine. The vast majority of Milan's restaurants in 2004 offered Italian cuisine. We define any restaurant offering non-Italian food as "ethnic."

We conduct this analysis on the subset of establishments (31.7 percent and 33.9 percent of sit-down restaurants in 2004 and 2012, respectively) for which we have data on price, quality, and cuisine.

In Figure 4, we divide neighborhoods in quartiles, based on their 2004–2012 growth in per capita number of restaurants. For each quartile, the first panel shows the 2004–2012 change in the within-neighborhood standard deviation of the price of a meal. It shows that neighborhoods that experienced a large increase in the concentration of restaurants—like those in the top quartile (Q4)—also experienced a significant increase in the dispersion of restaurant prices within the neighborhood. Thus, consumers looking for a restaurant in this group of neighborhoods could find a significantly more diverse set of price options after the reform (compared to before). By contrast, neighborhoods that experienced small increases or decreases in the concentration of restaurants—like those in the bottom quartile (Q1)—experienced a decline in the dispersion of restaurant prices. Consumers looking for a restaurant in this group of neighborhoods enjoyed fewer options after the reform (compared to before) because they faced a more homogeneous set of price options.

The second panel shows a similar pattern for the standard deviation of quality ratings. Areas with large increases in the concentration of restaurants also experienced an increase in the dispersion of quality ratings, while areas with smaller increases or decreases in the concentration of restaurants experienced a decline in the dispersion in quality ratings.

The bottom panel focuses on type of cuisine. We interpret increases in the number of ethnic restaurants as increases in the diversity of type of cuisine. The figure shows that the share of ethnic restaurants grew more in areas with large increases in the concentration of restaurants (Q3 and Q4) and grew less in areas with small increases or decreases in the concentration of restaurants (Q1 and Q2).

Of course, we don't interpret these relationships as causal. Rather, we interpret them as equilibrium relationships that document how price, quality, and type of cuisine vary with the endogenous changes in the number of restaurants in a given neighborhood.

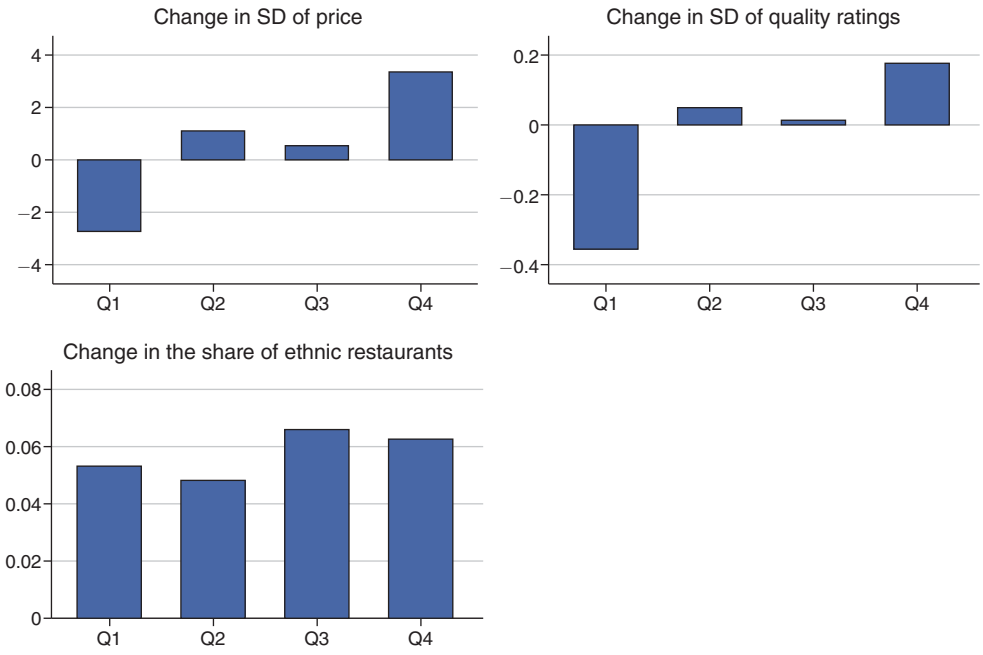

Figure 4. Changes in the Within-Neighborhood Dispersion of Restaurant Prices and Quality Ratings and in the Prevalence of Ethnic Cuisine

Notes: The unit of analysis is a neighborhood. Neighborhoods are divided into quartiles based on the percent change in per capita number of restaurants between 2004 and 2012. The first quartile includes neighborhoods with the smallest percent change in per capita number of restaurants between 2004 and 2012. The fourth quartile includes neighborhoods with the largest percent change between 2004 and 2012. For each quartile, the first panel shows the 2004–2012 change in the within-neighborhood standard deviation in the price of a meal. The second panel shows the 2004–2012 change in the within-neighborhood standard deviation in quality ratings. The third panel shows the change in the share of ethnic restaurants between 2004 and 2012.

Since we have data on product differentiation only for a subset of restaurants, we are concerned about sample selection. A regression of the 2004–2012 change in neighborhood share of sit-down restaurants for which we have differentiation data on the 2004–2012 change in the number of restaurants uncovers no significant relationship between the two variables $(0.0172(0.0956))$, suggesting that sample selection is unlikely to be a major driver of our findings.

Overall, these findings are consistent with the notion that restaurants located in neighborhoods where the concentration of restaurants increased reacted to the increased competition by differentiating themselves by price, quality, and cuisine.

IV. Conclusion

We conclude that agglomeration externalities played an important role in determining the location of restaurants across neighborhoods in Milan and their type. If this is true in other cities, it implies that the spatial concentration of establishments that we observe in most cities of the world reflects at least in part endogenous agglomeration economies, not just exogenous neighborhood characteristics or zoning constraints. While it may take years for agglomeration economies to fully

manifest themselves, the experience of Milan indicates that they are strong enough to profoundly affect the quantity and quality of the urban amenities available in each neighborhood.

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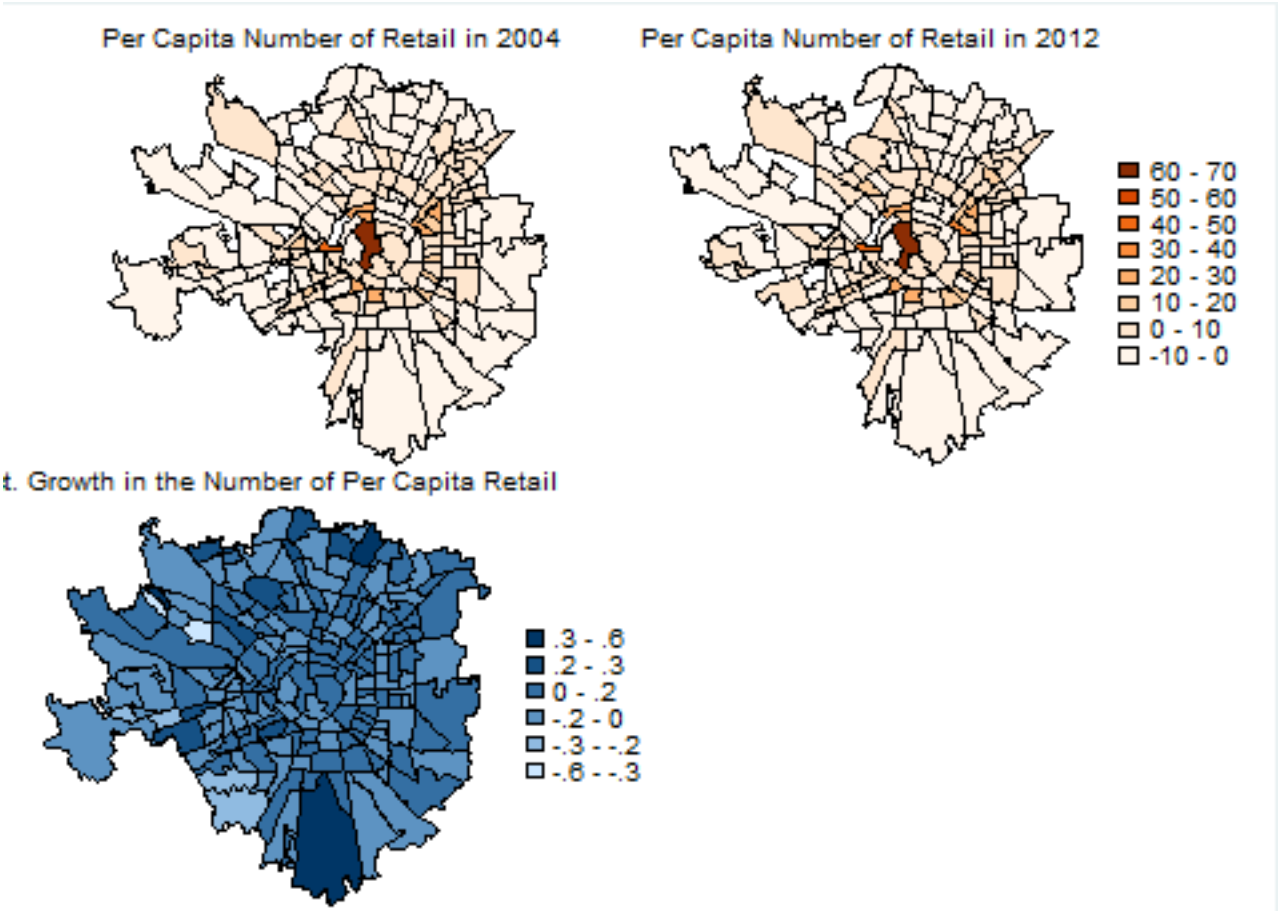
ONLINE APPENDIX

The Agglomeration of Urban Amenities:Evidence from Milan Restaurants

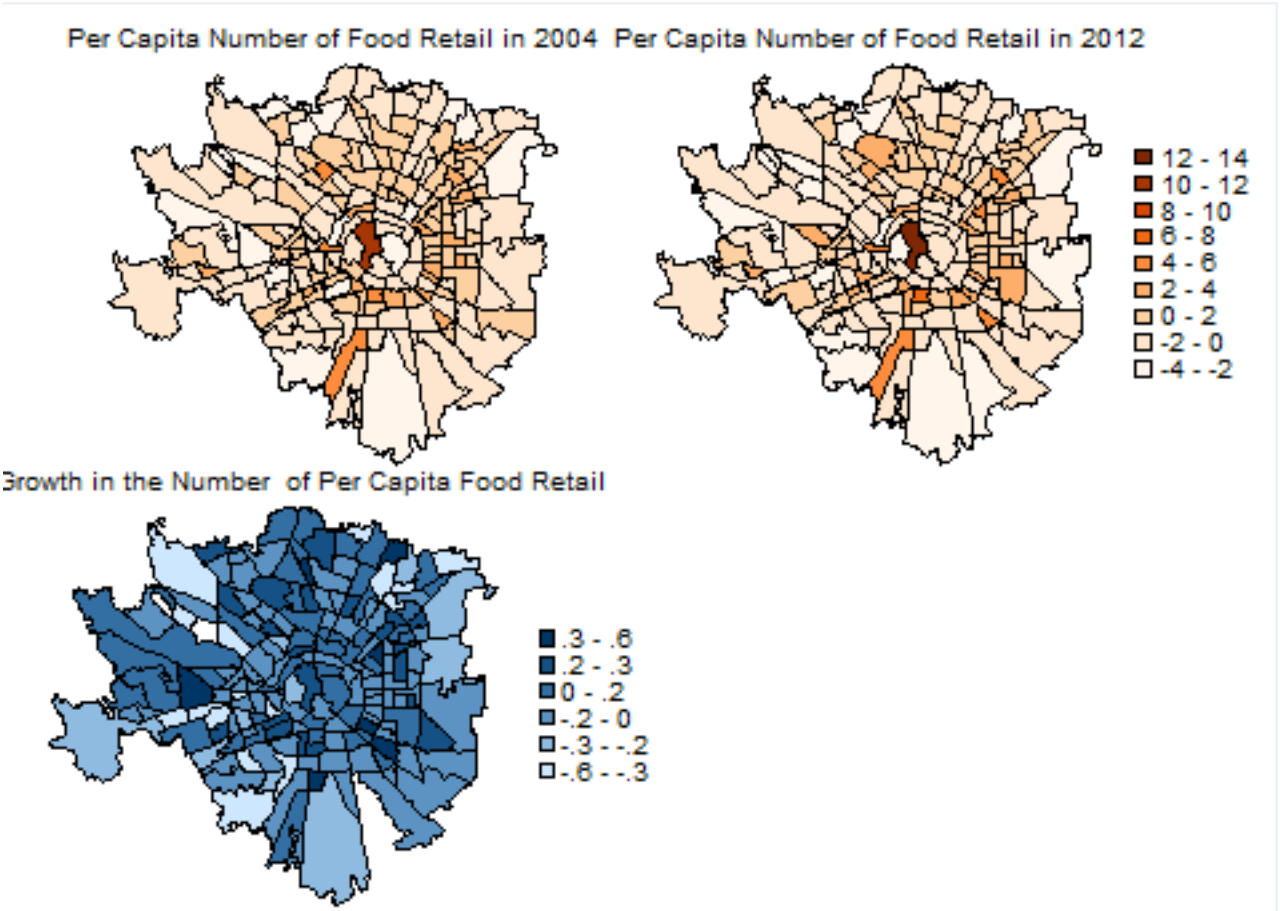
Marco Leonardi and Enrico Moretti

Figure 1: Per-capita Number of Retail Establishments by Neighborhood in 2004 and 2012 (Relative to City Average) and Percent Change between 2004 and 2012



Note: The map shows the per capita number of retail establishment in each neighborhood in 2004 and 2012, relative to the city average, and the percent growth 2004-2012. There are 180 neighborhoods.

Figure 2: Per-Capita Number of Food Retail by Neighborhood in 2004 and 2012 (Relative to City Average) and Percent Change between 2004 and 2012



Note: The map shows the per capita number of food retail establishment in each neighborhood in 2004 and 2012, relative to the city average, and the percent growth 2004-2012. There are 180 neighborhoods.

Table 1: Descriptive Statistics

	N (1)	Mean (2)	Std. Dev. (3)
Before the Reform: Years 2000-2004			
Per capita number of restaurants (per 1000 of people) 2000-2004	180	3.92	2.14
Per capita number of retail establishments (per 1000 of people) 2000-2004	180	14.99	8.96
Per capita number food retail establishments (per 1000 of people) 2000-2004	180	3.40	1.63
Daytime population in 2001	180	8361.57	8179.20
Mean House Price in 2004 (Euro/sq meter)	180	2590.24	730.88
Mean Commercial Price in 2004 (Euro/sq meter)	180	2066.94	801.73
Neighborhood has a Michelin Restaurant in 2004	180	0.25	0.44
Neighborhood Has a Subway Stop in 2004	180	0.33	0.47
Neighborhood has a College or University in 2004	180	0.02	0.16
Neigh. has a Significant Tourist Attraction in 2004	180	0.01	0.12
Mean Price of a Restaurant Meal in 2004 (Euro)	140	33.15	10.42
Mean Consumer Food Quality Rating in 2004	140	6.96	0.57
Share of Ethnic Restaurants in 2004	180	0.05	0.06
After the Reform: Years 2006-2012			
Per capita number of restaurants (per 1000 of people) 2006-2012	180	4.26	2.47
Per capita number of retail establishments (per 1000 of people) 2006-2012	180	16.13	9.82
Per capita number food retail establishments (per 1000 of people) 2006-2012	180	3.43	1.79
Mean Price of a Restaurant Meal in 2012 (Euro)	139	38.31	10.77
Mean Consumer Food Quality Rating in 2012	139	6.92	0.52
Share of Ethnic Restaurants in 2012	180	0.11	0.09

Notes: The unit of analysis is a neighborhood. Means for the period 2000-2004 are taken over the years 2000, 2002 and 2004. Means for the period 2006-2012 are taken over the years 2006, 2008, 2010 and 2012.

Table 2: Changes in Three Measures of Spatial Dispersion of Restaurants, Retail Establishments and Food Retail Establishments

	Std Dev (1)	p75-p25 (2)	p90-p10 (3)
		Restaurants	
Change 2000-2004	0.029	-0.182	-0.022
	(0.029)	(0.156)	(0.153)
Change 2004-2012	0.579***	0.767***	1.129***
	(0.094)	(0.193)	(0.441)
(Change 2004-2012) - (Change 2000-2004)	0.549***	0.950***	1.150***
	(0.093)	(0.276)	(0.462)
		Retail	
Change 2000-2004	1.209*	0.411	-0.319
	(0.695)	(0.594)	(0.674)
Change 2004-2012	0.382*	-0.483	1.292
	(0.231)	(0.517)	(0.894)
(Change 2004-2012) - (Change 2000-2004)	-0.827	-0.893	1.610
	(0.520)	(0.900)	(1.273)
		Food Retail	
Change 2000-2004	0.159	-0.066	-0.042
	(0.130)	(0.148)	(0.252)
Change 2004-2012	0.216***	0.305	0.090
	(0.103)	(0.210)	(0.296)
(Change 2004-2012) - (Change 2000-2004)	0.057	0.370	0.132
	(0.090)	(0.273)	(0.424)

Notes: The unit of analysis is a neighborhood. There are 180 neighborhoods. Bootstrapped standard errors (200 replications) in parentheses. $^{*}p < 0.1; ^{**}p < 0.05; ^{***}p < 0.01$